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The Flora of our South-western Archipelago. I.

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Under this very general heading, extended reference will be made to the flora of Guadalupe Island, which though lying far to the south of the Santa Barbara group, and without the territory of the United States, is affected by so many phenomena and conditions identical with those existing upon the more northern islands, that as might be expected the floras of each reveal many features of common interest and, as we expect to show, common relationship.

Speculations as to the origin, development and limitations of insular species enhance in value with the extent of the field under observation. With this end in view casual reference will be made to plants characteristic of islands other than those under direct consideration, but of whose flora our knowledge is still so fragmentary and imperfect, that until exhaustive collections shall have been made therefrom, ultimate conclusions based upon such references must be largely hypothetical and subject to future modifications.

The writer has enjoyed the rare advantage of several visits at different seasons of the year to some of the islands of the Santa Barbara Archipelago; made copious collections and field notes, and had, possibly (thanks to the courtesy of the San Clemente Sheep and Wool Company, and to the principal lessee of Santa Catalina Island), better facilities for the careful and extended observation of their respective floras, than had Messrs. Dall, Gambel, Wallace or Dr. Cooper, who had previously made brief excursions to one or more of these islands.

As for the islands to the south, Prof. Watson's admirable monograph on the "Flora of Guadalupe"[1] and the recent vigorous paper on the same subject by Mr. Greene,[2] together with ample specimens from Guadalupe, Cedros and the adjacent mainland, kindly communicated by the latter gentleman, has supplied me with invaluable material for a fair comparison of the flora of these islands with each other and with the immediate continent.

The general physical conditions existing upon our west coast islands seem to favor rapid and striking modifications in organic life, and if we show this to be the case, then their products afford

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[1] Contributions to American Botany by Sereno Watson, Proc. Am. Acad. XI, Feb. 1876.

[2] Studies in Bot. of Cal. and parts adjacent, by Rev. Ed. Lee Greene, in Bull. Calif. Acad. No. IV.

interesting material for the study of the durability and stability of species.

The short interval of ten years between Dr. Palmer's and Mr. Greene's visit to Guadalupe points strongly to the possible extinction of some species, the introduction or genesis of others.

Notably in the cases of Hosackia grandiflora, Juniperus Californica var. osteosperma and Polypodium Scouleri,[3] we apparently have examples of extinction proceeding at a rate sufficiently rapid to bring it within the observation of a single generation of man.

On San Clemente I noted in great profusion the lifeless stem and root of a Cotyledon and can readily credit the statement made to me that only eight years ago the island was fairly carpeted with this plant. A season of drouth drove the sheep to feed upon it, and it is easy to conceive that a succession of better years by affording more wholesome pasture and thus diverting the attention of the stock might enable the species from the few remnants left upon wholly inaccessible rocks to once more regain its pristine supremacy.

A species reduced to the verge of annihilation, or to so critical a condition as the Guadalupe Juniper, might, through a short succession of seasons of ample rainfall, be readily restored to its original vigor.

These somewhat forced illustrations are used to emphasize the fact that on little known islands the utter extinction of species is and will be a difficult matter to establish beyond a doubt. The same remarks apply in reference to the supposition of the recent introduction or creation of new species; some in such abundance now as makes it seem improbable that they should have escaped the keen scrutiny of the expert collector; yet in default of affirmative proof to the contrary, we must ascribe their absence to the first collector's omission rather than to the hypothesis stated.

Though entirely out of order to criticise any part of Mr. Watson's paper at this late day, I can not but express surprise that so conservative an author in drawing his final inferences should lay particular stress upon the absence of certain orders and genera of plants upon Guadalupe.

Due recognition does not seem to have been given to the fact that Dr. Palmer's collections were made in the spring and early summer, and hence (if the flora be at all Californian) would entirely fail to illustrate any of the later flowering Compositæ or Polygonaceæ.

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[3]Bull. Cal. l. c., p. 210.

Many species of Eriogonum would scarcely be showing above ground by the end of May. In June, 1884, after a season of unprecedented rainfall and retarded vegetation, I could find no trace of Eriogonum nudum upon Catalina; the same localities revisited in July, 1885, a season of early maturity, showed an abundance only half-grown, and it was not finally obtained in perfection until October, of the same year.

Mr. Greene's discovery of Brodiæa capitata in abundance on Guadalupe conflicts with "the almost entire absence of Liliaceæ",[4] though failing to see any representative of that order upon Mr. Watson's list, the "almost" might have perhaps been altogether suppressed.

That the occasional errors which appear in scientific reports are due to the hasty ill-digested notes of explorers is illustrated in the published accounts of some of these islands.

Dr. Cooper found San Clemente to be "an island with scarcely any soil covering the rocks" * * * * * * "and seems never to have been much resorted to by animals."[5] The first of these propositions is true only of the immediate neighborhood of the usual landing, which is environed by sterile rocks, and at low points along the coast by long reaches of barren sands. The mesas or table lands of the interior, however, show a great extent (many thousands of acres) of fine organic soil of great depth and apparent unbounded fertility. The second proposition is almost as faulty; of marine mammals such as seals, sea lions, etc., it has always, until exterminated, been the favored resort; while the island, since the earliest settlement of the country, has been overrun with field mice and a pretty little gray and red fox, the latter peculiar to the Santa Barbara group, and reported as never having been found on the adjacent mainland.

The absence of soil would imply the absence of much vegetation, combined with absence of animals it would imply a country almost unfitted to sustain organic life, and convey to the average mind a desert or howling wilderness, instead of a land of promise capable with water development of great possibilities. The same authority reports the existence of "one good spring of water upon Catalina," another statement which, though undoubtedly true, is hardly comprehensive enough, as after a season of unusual drouth (1885), the writer noted forty-two springs, streams, wells or different sources of water upon that island.

In comparing the floras of these islands with each other and

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[4] Proc. Am. Acad. l. c. p. 3.

[5] Geology of California.—Vol. I. p. 183.

with Guadulupe, a brief geographical sketch of the principal islands of the Santa Barbara archipelago seems unavoidable.

Santa Catalina lies a little southwest of the shipping port of San Pedro, Los Angeles county, Cal., distant about twenty miles. Clemente has nearly the same bearings from San Pedro, and is some fifty miles distant. These islands as respectively named, are about twenty and twenty-two miles long with varying widths of three to eight miles. Both lie nearly northeast and southwest, and in shore line conform generally to the trend of the coast at Santa Barbara. Both are of volcanic origin; Catalina showing not only extensive lava masses but a well defined crater, and probably, like Guadalupe, was the result of one subterranean upheaval or disturbance.

Like that island, it is traversed for its length, excepting only at the isthmus near the west end, by a lofty and terribly precipitous mountain chain which, branching occasionally, makes place for several large, fertile, well-wooded and well-watered valleys.

Clemente is unquestionably the product of many upheavals, proven by the succession of terraces extending for its whole contour. The fact that the sea along the line of its former tide levels has not only smoothed and worn the faces of these adamantine basalt terraces, but mined great caves in them, is sufficient evidence to assume vast lapses of time between some of these disturbances. This porphyry formation, overlaid with a great depth of soil where shown by the excavations made by Indians when walling in their villages or walling out the winds, together with the terrace formations is enough to justify us in claiming for this island an antiquity far greater than either Catalina or Guadalupe. If this be true, then we might reasonably expect to there find a flora more distinctively peculiar than that pertaining to either of the other two islands. Such is not the case, however, and the geology of the island apparently is not verified by the botany as we now find it. Whether this apparent antagonism is real or fictitious, and due, and to what extent, to modifications arising from artificial or external causes, we will endeavor later to determine. As in Guadalupe, ice and snow are not of rare occurrence in the mountain valleys of Catalina, although the lesser elevation of Clemente probably exempts it from these phenomena.

Neither of the northern islands show any signs of the tropical vegetation (Erythæa) obtained in Guadalupe.

Lying more in the lee of islands to the north (Santa Cruz, Anacapa and Santa Barbara), the channel which separates Santa Catalina from the mainland is always smooth and pacific, save in the rare instance of the southeast gales, and from that island's

greater proximity and readier accessibility to the mainland, as might be expected, it shows a larger preponderance of continental forms of vegetation than exist on either of the others.

The outward channel to Clemente is often boisterous in the extreme; and the long, unbroken surges of the Pacific give the squeamish traveler in a small boat the full flavor of a protracted sea voyage.

Nearly identical climatic conditions prevail on all three; cooler in winter than the mainland, hotter and drier in summer on the south sides, owing to the deflection of the cooling fogs by the mountain tops.

The prevailing winds and ocean currents are similar to those affecting Guadalupe, and whose nature and influence has been so clearly and ably set forth by Mr. Watson, that I can not do otherwise than refer for the details to his admirable paper.[6] Therein he shows the nature of our prevailing winds are in every way antagonistic to the introduction of continental species to Guadalupe; curiously he seems to have overlooked the converse of this proposition, which would be that this agency would actively favor the distribution of insular species to the mainland.

Whilst recognizing as a factor, I am of opinion that the value attached by authors to the common media of seed transmission, *i. e.*, agency of man, beasts, birds, watery currents and winds, is somewhat over-estimated; the history of our island plants tends to confirm and strengthen this belief.

1. The case of *Malacothrix insularis* Greene, and *Lavatera insularis* Wats. confined to the Coronados Isles, though only distant seven miles from the mainland.

2. The limitation of at least three well-defined species to Cedros,[7] which with the island of Natiridad forms the western barrier of San Sebastian bay, Lower California, and whose topography would seem to indicate that at no distant epoch they formed a continuous part of the mainland.

3. A new species of Pentachæta, found originally near San Pedro in the spring of 1884 and confined to the area of a few square yards, was the following year traced to its original habitat on Catalina Island. The spot where found on the mainland has been for twenty-five years past constantly used for pasturing

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[6] Proc. Am. Acad. l. c., p. 107.

[7] Veatchia Cedrosensis, Œnothera Cedrosensis and Senecio Cedrosensis.

No account is taken of *Krynitzkia Cedrosensis* Greene, less on account of its doubtful specific value than from the fact that apparently confluent forms have been collected on the mainland; but the whole genus is regretfully excluded from our consideration; the burr like character of the fruit makes it peculiarly available for artificial distribution and the establishment of a well-defined species so near the mainland, yet limited to the island, would be a potent argument in behalf of the opinion expressed.

sheep just disembarked from that island, and the case cited is probably as direct evidence of the agency of animals in seed distribution as any that could be quoted; nevertheless, with every circumstance conspiring during very many years to favor its introduction in manifold, the total "crop" of 1884 might readily have been the product of one fertile akene growing and maturing the previous year!

4. Prunus occidentalis is a species which, from its abundance, gives character to the vegetation in parts of Catalina. Its great size (25 feet) and conspicuous beauty seem to preclude the possibility of its having escaped the notice of the most unobservant explorers of islands to the north or south, and it is probably safe to assume its confinement to this island alone of all on our western coast, yet it is reported to me as native of the West Indies. The abundance of young and flourishing seedlings indicate that it germinates readily; while its large and luscious drupe greedily fed upon by squirrels, sheep, goats, birds and man would seem to provoke its widespread and rapid distribution. It grows far up on the roughest interior mountain ridges at an elevation of 3,000 feet, and down the fertile valleys and cañons to the very water's edge; at all altitudes and all exposures it flourishes with unequaled vigor, yet no trace of it exists on Bird Island, barely two miles distant.[8]

5. A somewhat analagous case is that of the Lavateras. This genus is largely represented on most of our western islands, from Anacapa on the north to San Benito, Lower California, on the south, with probably no congener on the mainland other than escapes from gardens where it has been largely planted. Yet the genus is indigenous to the south of Europe and adjacent islands: that it should owe its presence in the occident to the common methods of seed dispersion and leave no trace upon intervening continents is somewhat improbable: that it is due to systematic transplantation upon uninhabited islands is more than improbable —it is an unreasonable supposition.

That a great ocean is not an insurmountable barrier to the migration of species is a fact commonly known. A single Asiatic species of Castilleia illustrates it; yet that genus sweeps along the whole western coast of North and South America, from Arctic to Antarctic zones, and the chances have weighed heavily in its favor of finding an outlet from some of its myriad sources: no such conditions, however, obtain in the case of the Lavatera or

[8] For the benefit of botanists who have not seen it I wish to say that P. occidentalis is a most beautiful tree whose symmetrical form, glossy coriaceous leaves and white flowers approximates in appearance an orange tree, and in some valleys it forms unique plantations every way comparable to an orange grove.

still more restricted Prunus. That the physical conditions surrounding our island plants are extremely favorable for the rapid development, perfection, retrogression and perhaps ultimate extinction of new species, certain observations of their habits tend to show.

Of plants or species found conjointly upon the islands and mainland, the island forms are inclined to vary. The variation the most uniform and striking of all is in the preponderance of giant growths.

Brodiæa capitata on Guadalupe, though restricted in area, was of such great size as to elicit surprise from Mr. Greene that it should have escaped the notice of his predecessor, Dr. Palmer. The same plant on Clemente, also within narrow limits, showed the same immense habit. Mr. Watson unqualifiedly referred it to B. capitata, only noting immense size and a trifling difference in the stamens, not enough to justify varietal rank. Its absence from Catalina, apparent absence from Guadalupe only ten years ago, and scarcity on Clemente, induces me to think that not only is it of recent introduction from the mainland, where in many localities its abundance gives character to the spring vegetation, but that it is even now in a transitional state. That the presence of identical physical conditions should elaborate similar forms on even widely sundered islands, is not improbable; hence, to quote the ideas, if not the words of the distinguished author of "Plant Variations," it is not difficult to believe, that on each island, within a few plant generations, we may witness the outgrowth of a distinctively new type, sprung from a common stock, but different individuals, and varying from the parents with similar variations. This hypothesis would cover the case of the Prunus (the genus being continental), provided we could show co-existence at some past time of like conditions upon Catalina and its present West Indies habitat.

I revert once more to the genus Lavatera as showing not only abnormal development of island species, but illustrating the facility of some species to become exhausted or extinct when palpably uninfluenced by any other than strictly natural causes.

It is commonly known that very many plants, with skillful manipulation, "improve" under cultivation; *i. e.*, at least increase the size of flower and leaf. This is anything but the case with Lavatera assurgentiflora, which I collected on Clemente from larger plants, in finer foliage and greater size and brilliancy of flower than anything observed in gardens. Its introduction into cultivation, and from having become occasionally spontaneous

upon the mainland, must forever be a bar to its complete extirpation; yet the *natural* tendency of the species I think we can show to be on the decline or toward extinction. Sealers report that once abundant upon Anacapa and San Nicolas, it is now scarce; on Clemente, it was only observed in two localities, and only one or two plants in each; yet only a dozen years ago it constituted unbroken forest, extending for miles upon the high plateaus. Extraneous causes alone are not sufficient to account for its disappearance; the few luxuriant specimens left are readily accessible to sheep and goats, and their ravages unsupported will not explain away its manifest decadence.

No trace of it is found on Catalina Island, and Bird Island, a rugged, rocky islet not two miles distant, carries it in some profusion. The latter island is not used for grazing stock, while Catalina is; yet a resident on that island before the first sheep or goat was introduced, thoroughly familiar with the plant, and for whose close observant power I have the highest respect, assures me that he has never seen a single plant within its limits.

Of other plants having mainland representatives, and whose heroic size arrest attention, we may briefly mention Solanum Xanti, var. Wallacei—a rank growing form.

Of Ceanothus sorediatus, from Catalina, Dr. Gray says, "never saw it before in such large leaf and fruit."[9] On the southern mainland a straggling shrub of 12 to rarely 15 feet; here it becomes a tree of 25 feet.

Our common Convolvulus occidentalis of the mainland becomes the well defined *C. macrostegius* Greene, although in elaborating the species he lays no especial stress upon its size.

Elymus condensatus in rich damp soils is not infrequently 6 feet or more upon the mainland; in dry sterile places on Catalina it overtops a tall man on horseback.

The genus Eriogonum which we readily recognize by its preponderance of tiny forms and slender, delicate habits of growth, confounds all our preconceived ideas by developing into immense arborescent species upon the islands. *E. arborescens* Greene of Santa Cruz I have not seen, but from name and description it presents a marked difference from anything continental. *E. giganteum* Wats. shows a contrast still more striking, outstripping in heroic dimensions anything yet known in the genus. Not rarely a bush 10 feet in height and the same diameter, uniformly topped with its magnificent cream-colored cymes eighteen inches

[9] In a letter. = C. arboreus, Greene! Spec. vid,

in diameter, it forms one of the most beautiful and interesting features of our island flora.

Prunus illicifolius Walp. on our coast range mountains a small leaved, straggling shrub; on Catalina becomes a stately tree of 50 feet with leaves $2\frac{1}{2}$ inches long.

Audibertia polystachya of abnormal size occurs on Catalina, and current with it A. Palmeri, common also to Guadalupe; the readiness of the genus to commingle and hybridize might lead us to anticipate under insular influences many modifications; none, however, were noted except in that of size.

The genus Rhus may be mentioned here as not only the genus of plants more than any other which from its abundance of individuals and species gives character to the vegetation of the island, but as might be expected shows a tendency to vary if not noticeably in size, at least in a manner not observed upon the mainland.

R. integrifolia was collected with very many ternate leaves, but in all other respects strictly identical with the normal type; observed in two widely diverse localities and in profusion. This form possesses great interest as marking perhaps the initial steps to subsequent specific modifications.

Leptosyne gigantea, another large type of probably strictly insular origin, is rapidly disappearing from at least the northern islands. The liking of man and beast for its succulent foliage as "greens" and "pasture" may account for its reported collection on the mainland, where it may obtain a stable footing, otherwise it must sooner or later have fallen within the great catalogue of unnamed ephemeral species which have once flourished, been modified, fallen into decadence or disappeared forever.

Examples could be multiplied, but the list as given is sufficient to show the activity of physical conditions upon these islands in the production of ultra vigorous vegetable growth. Further it should not be forgotten that the collections upon which these notes are based were made in a season of unparalleled drouth, when the collection of depauperate specimens upon the mainland was the rule, a season so adverse to the development of abnormal luxuriance in vegetation that the fruits of many species for the collection of which I especially revisited Catalina in October of last year, failed to mature seeds of germinative power.